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Quality assessment of cakes supplemented with cashew pomace and soybean flour

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ABSTRACT

The study investigated the quality of wheat flour (WF) cakes supplemented with cashew pomace (CPF) and soybean flour (SBF). The chemical and functional properties of WF, CPF and SBF were assessed. The CPF (30%) and SBF (70%) were blended to produce composite flour. The CPF/SBF composite was used to substitute 5, 10,15,20,25 and 30% WF in cakes which were assessed for their physical, sensory and chemical properties. The results showed that SBF contained higher amounts of ash, protein and fat than CPF and WF. However, CPF had higher crude fiber and carbohydrate contents than SBF and WF. The SBF possessed higher oil (208%) and water (168%) absorption capacities than CPF and WF while the water (160%) and oil (95%) absorption capacities of CPF were higher than those of WF. The foaming and emulsion properties were higher in WF, which was followed by SBF. The least gelation concentration of CPF, WF and SBF were 8, 10 and 12% (W/V), respectively. The cakes had the same diameter (6.1cm) and width (8.3cm). However, the weight and height of cakes decreased with increased level of CPF/SBF in the blends. The cakes containing up to 20% CPF/SBF were not significantly different (P>0.05) from 100% WF cakes in the sensory attributes assessed. The 20% CPF/SBF based cake had higher amounts of ash, protein and crude fiber than the traditional wheat flour cake.

Keywords: Cake, Supplementation, Cashew pomace, Soybean, Quality evaluation.

1. INTRODUCTION

Cashew (*Anacardium occidentale*) tree is ranked second to only almond among the nine tree nuts that are of importance in the world trade. The weight of cashew apple is about 5 to 10 times the weight of the nut, corresponding to a world annual production of between 2.5 and 5 million tonnes of fruit (Ohler, 1979). The nut is processed into kernel which is used for various food products. However, use of cashew apple is of minor economic importance, the greater part being wasted. Products processed from cashew apple on experimental basis or on a home scale include fruit paste, candied fruit, jam, jelly, wine and vinegar. The residue after expression of juice from the apple is called cashew pomace. Cashew pomace is considered as waste in most countries. However, it is reported to contain 72% moisture, 2.5% protein, 10.92% carbohydrate, 1.4% fat, 1.5% crude fiber, 1.1% ash, calcium, phosphorous, iron in addition to essential vitamins and phytochemicals with antioxidant activity. In several countries, including India, fresh cashew pomace is used to feed pigs. However, because cashew pomace is low in protein content, pigs fed on it would not receive adequate intake of protein. Cashew pomace could be processed into flour and used in similar manner to other flours. In the previous study, cashew pomace was investigated in biscuits in order to reduce its environment impact as well as to provide application for the pomace. Biscuit containing 10% cashew pomace flour was not significantly different from 100% wheat flour biscuit in all the sensory attributes studied (Osuji, 2006). Hence, demonstrating the potential of cashew pomace waste as alternative raw material for biscuit making. However, the biscuit contained only 4.5% protein (Osuji, 2006) which makes it nutritionally inadequate. However, the protein content of the wheat /cashew pomace flour bisciut could be improved by incorporating protein rich foods such as soybean.

Soybean is a cheap source of protein that is superior to all other plant foods because of its good balance of essential amino acids. Thus, soybeans, with 40% protein (Akubor & Ukwuru, 2003) have great potential in solving problems of protein malnutrition. In this regard, several food products have been enriched with soy protein to improve protein quality without loss of palatability (Akubor & Ukwuru, 2003). In such foods, soybean promotes desirable health benefits as soybean isoflavones provide beneficial effects against most of the common disorders affecting humans, including cancer (Messina & Barnes, 1991). The physiological effects of soy isoflavones have been reported to include lower risk of cardiovascular, inhibition of bone resorption, growth inhibition of human breast and prostate cancer cells, antioxidative properties and ability to lower cholesterol levels (Messina & Barnes, 1991) These properties have increased the use of soybeans in food formulations for there are scientific evidences supporting the role of diet in overall health and well-being. For instance cancer, coronary heart disease, stroke, diabetes, atherosclerosis and liver disease have been increasingly shown to be related to diet. With expanded consumption and production of cashew fruits and soybeans, and the increased demand for healthy nutrition, comes the need for investigating the quality of cake from these crops. Thus, the objective of this study was to determine the quality of cashew pomace based cake supplemented with soybean flour.

2. MATERIALS AND METHODS

2.1. Raw material procurement

Mature and ripe cashew (*Anacardium occidentale*) fruits were harvested from a local farm while wheat flour and other ingredients were purchased from a local marker, all in Idah Township, Kogi state, Nigeria. The fruits and the ingredients were stored in a refrigerator (10^0C) prior to use.

2.2. Preparation of cashew pomace flour

The fruits were sorted and washed in enough tap water contained in a basin. The nuts were removed and juice was extracted from the apple by squeezing. The cashew pomace was cut into thin slices (2cm thick), blanched in 1% (w/v) sodium metabisulphite solution at 100^0C for 10 min, drained and then oven dried at 50^0C to constant weight. The dried slices were milled in attrition mill, sieved through 60 mesh sieve (British standard}, packed in HDPE bags and stored in a refrigerator prior to use.

2.3. Preparation of soybean

The soybean seeds were cleaned, washed in tap water and boiled at 100°C for 30min in a plan aluminum pot with a lid. The parboiled seeds were dehulled manually, washed in tap water and oven dried (5O°C) to constant weight. The kernels were milled in attrition mill, sieved through 60 mesh sieve, packed in HDPE and stored in a refrigerator prior to use.

2.4. Flour blending

The cashew pomace flour (CPF)(30%) and soybean flour (SBF)(70%) were blended in a food blender operated at full speed for 10 min. Wheat flour was then used to substitute 5,10,15,20,25 and 30% of the CPF/SBF composite in a food blender. The flours were stored in HDPE bags prior to use.

Table 1
Chemical composition of cashew pomace flour (CPF), soybean flour (SBF) and wheat flour (WF)

Parameter (%)	CPF	SBF	WF
Ash	$2.40^b \pm 0.08$	$3.20^a \pm 0.06$	$0.9^c \pm 0.04$
Moisture	$8.40^b \pm 0.01$	$8.50^b \pm 0.01$	$9.0^a \pm 0.08$
Crude protein	$6.20^c \pm 0.04$	$38.60^a \pm 0.04$	$10.0^b \pm 0.4$
Crude fat	$1.20^b \pm 0.05$	$20.80^a \pm 0.01$	$2.0^b \pm 0.06$
Crude fiber	$4.30^a \pm 0.07$	$3.00^b \pm 0.02$	$0.9^c \pm 0.02$
Carbohydrate	$77.5^a \pm 0.03$	$25.9^b \pm 0.08$	$77.2^a \pm 0.07$

Values are means ± SD of 3 replications .Means within a row with the same superscript were not significantly different ($p>0.05$).

2.5. Preparation of cake

Cakes were prepared from the flour blends according to the formula of Nishibori & Kawashiki (1990). The recipe used for the preparation of cakes was composed of flour (30g), margarine (18.6g), salt (0.12g), milk (12.0g), egg (0.6g), sugar (12g), water (25.98ml) and baking powder (0.75g). The dry ingredients were weighed and mixed thoroughly. Margarine was added and rubbed in until thoroughly kneaded. The dough was cut out and baked in greased pans in an oven at 16o°C for 20min.

2.6. Analytical methods

2.6.1. Physical evaluation

The height, diameter and width were measured with vernier caliper. Weight was determined with digital weighing balance. Volume was determined by seed displacement method (AOAC, 1995). Density was calculated as weight/volume.

2.6.2. Chemical evaluation

Moisture was determined by hot oven drying at 105°C to constant weight (AOAC, 1995). Ash, protein (Nx6.25), crude fiber and fat were determined by the AOAC (1995) methods. Carbohydrate was calculated by difference (100% - (%Moisture % Ash +%fat %protein +%crude fiber).

2.6.3. Evaluation of functional properties

Bulk density was determined as described by Okaka & Potter (1977). Water and oil absorption capacities were determined at ambient temperature following the methods of Sosulski et al., (1976). Emulsion activity and emulsion stability were determined by the methods of Okaka & Potter (1977). Foaming capacity (FC) and foam stability (FS) were measured by the methods of Sathe et al., (1982). The volume of foam at 30sec of whipping was expressed as FC. The volume of foam was recorded hour after whipping to determine FS as percent of the initial foam volume. The least gelation concentration was determined as described by Okaka & Potter (1977).

2.6.4. Sensory evaluation of cakes

The cake samples including 100% wheat flour cake were evaluated for colour, flavour, taste and overall acceptability on 5-point Hedonic scale (1=dislike extremely and 5=like extremely (Ihekoronye & Ngoddy, 1985). The cakes were evaluated by twenty trained panelists randomly selected from students and staff of The Federal polytechnic community, Idah, kogi state, Nigeria. The cakes were presented to the panelists in 3-digit coded plastic plates. The order of presentation of the cakes to the panelists was randomized. The sensory evaluation was carried out in a sensory evaluation laboratory under white light and adequate ventilation. Clean tap water was provided for the panelists to rinse their mouths in between evaluations.

2.7. Statistical analysis

All data were analyzed in 3 replicates. Data were subjected to analysis of variance as described by Steel & Torrie (1980). Means where significantly different were separated by the least significant difference (LSD) test. Significance was accepted at $P<0.05$.

3. RESULTS AND DISCUSSION

3.1. Proximate composition of flours

Table 1 presents proximate composition of the flours. The commercial wheat flour (WF) used in this study contained 0.9% ash, 9.0% moisture, 10% protein, 2% crude fiber and 77.2% carbohydrate. These values were comparable to previous literature reports on wheat flour (Akubor, 2003; 2004). Soybean flour (SBF) contained significantly higher levels of crude protein (38.6%) and fat (20.8%) than WF as well as cashew pomace flour (CPT) which had 6.2% protein and 1.2% fat. However, the levels of crude fiber (4.32%) and carbohydrate (77.5%) in CPF were higher than those of SBF which were 3 % crude fiber and 25.9% carbohydrate. The higher level of protein in SBF makes it a good protein supplement for CPF and WF. The moisture contents of the flours (8.4-9%) were within acceptable limit of not more than 10% for long term storage of flour (Akubor & Eze, 2012). Moisture at these levels would enhance storage stability by preventing mould growth and reducing moisture dependent biochemical reactions (Onimawo & Akubor, 2012).

The CPF could be a potential source of dietary fiber with some advantages over cereal grains and legume hulls as fiber source. This is because CPF has low phytic acid (Layokun et al., 1986) which renders minerals such as Zn, Mg and Ca unavailable. More importantly, the presence of bioactive compounds with antioxidant properties such as vitamin C and flavonoids in CPF (Ohler, 1979) exert further health promoting effects in addition to those of the dietary fiber.

Table 2

Functional properties of cashew pomace flour (CPF), soybean flour (SBF) and wheat flour (WF)

Parameter	CPF	SBF	WF
Bulk density (g/cm^3)	0.69^a ± 0.04	0.38^c ± 0.05	0.72^b ± 0.01
Oil absorption capacity (%)	95.0^b ± 0.05	208^a ± 0.07	91.0^c ± 0.09
Water absorption capacity (%)	164.0^b ± 0.09	168.0^a ± 0.08	75.0^c ± 0.01
Foaming capacity (%)	210^c ± 0.07	50.0^b ± 0.04	61.0^a ± 0.04
Foam stability (%)	16.0^c ± 0.04	20.0^b ± 0.01	40.0^a ± 0.03
Emulsion capacity (%)	29.13^b ± 0.05	19.0^c ± 0.04	37.0^a ± 0.04
Emulsion stability (%)	6.27^b ± 0.04	40.0^a ± 0.002	40.0^a ± 0.07
Least gelation concentration (%,w/v)	8.0^c ± 0.02	12.0^a ± 0.04	10.0^b ± 0.08

Values are means ± SD of 3 replications. Means within a row with the same superscript were significantly different ($p > 0.05$)

Table 3

Physical properties of cakes prepared from cashew pomace flour (CPF), soybean flour (SBF) and wheat flour (WF)

CPF/SBF: WF	Physical properties			
	Weight (g)	Height (cm)	Diameter (cm)	Width (cm)
0: 100	127^a ± 0.04	5.7^b ± 0.02	6.1^a ± 0.08	8.3^a ± 0.04
5: 95	125^b ± 0.01	5.5^c ± 0.04	6.1^a ± 0.04	8.3^a ± 0.10
10: 90	119^c ± 0.04	5.3^b ± 0.05	6.1^a ± 0.01	8.3^a ± 0.09
15: 85	115^d ± 0.02	4.9^{bc} ± 0.04	6.1^a ± 0.10	8.3^a ± 0.12
20:80	114^e ± 0.09	4.6^c ± 0.02	6.1^a ± 0.12	8.3^a ± 0.06
25:75	110^f 0.04	3.8^c ± 0.04	6.1^a ± 0.09	8.3^a ± 0.08
30: 70	105^g ± 0.09	3.4^c ± 0.01	6.1^a ± 0.10	8.3^a ± 0.09

Values are means ± SD of 3 replications. Means within a column with the same superscript were not significantly different ($p > 0.05$)

Table 4

Mean sensory scores of cakes prepared from cashew pomace flour (CPF), soybean flour (SBF) and wheat flour (WF)

Means (N=20) within a column with the same superscript were not significant different ($p>0.05$). CBF/SBF contained 70% SBF and 30% CPF. Cakes were evaluated on 5-point Hedonic scale (1=dislike extremely and 5= like extremely)

CBF/SBF:WF	Sensory attributes				
	Colour	Flavor	Taste	Texture	Overall acceptability
0 :100	4.4.^{a}	4.0^a	4.5^a	4.5^a	4.5^a
5 : 95	4.3^a	4.4^a	4.5^a	4.1^b	4.5^a
90 : 90	4.2^a	4.2^a	4.2^{ab}	4.0^b	4.5^a
15 : 85	4.0^{ab}	4.1^a	4.1^{ab}	4.0^b	4.1^{ab}
20 :80	3.7^b	4.1^a	4.1^{ab}	4.0^b	4.1^{ab}
25 : 75	3.6^b	4.1^a	4.1^{ab}	4.0^b	3.9^b
30 :70	3.6^b	4.0^a	4.0^b	4.0^b	3.8^b

3.2. Functional properties of flours

The functional properties of CPF, SBF and WF are given on Table 2. The bulk densities varied with the flours, SBF having 0.38g/cm^3 which was lower $p < 0.05$ than those of the CPF (0.69 g/cm^3) and WF (0.72g/cm^3). Bulk density which is an indication of the porosity of flours influences package design, material handling and application in wet processing of foods (Kinsella, 1987). The low bulk density of the flours implied that their packaging materials will be less dense which is economic in terms of packaging cost. The CPF and SBF would be useful in preparing complementary foods where less bulk is desired. The SBF possessed significantly higher oil absorption capacity (OAC) (208%) and water absorption capacity (WAC) (167%) than CPF and WF, probably due to its higher protein content. The OAC (95%) and WAC (164%) of CPF were higher than those of WF which were 91 and 75%, respectively. The CPF probably contained higher hydrophilic constituents such as carbohydrate and crude fiber than WF. Water absorption of fiber is dependant to some extent on pH and nature of the protein (Onimawo & Akubor 2012). Oil absorption capacity is attributed mainly to the physical entrapment of oils. It is an indication of the rate at which proteins bind to fat in food formulations (Onimawo & Akubor, 2012). The higher OAC of SBF suggested the presence higher apolar amino acids in SBF (Akubor & Ukwuru, 2003). The incorporation of SBF would improve the OAC and WAC of CPF and WF in food formulations. Water absorption characteristic represents the ability of flour to associate with water under conditions when water is limiting such as dough and pastes. The results of this study suggest that the CPF/SBF/WF blends would be useful in baked products which require hydration to improve handing characteristics. Oil absorption capacity is useful in sausages and bakery products (Akubor & Eze, 2012), suggesting that SPF/SBF/WF blends would be useful in this regards.

Wheat flour (WF) had higher foaming and emulsion properties than CPF and SBF. However, these properties were higher in SBF than CPF. Foamability of flours was reportedly varied with type of protein, solubility, pH etc (Onimawo & Akubor, 2012). The WF may have contained flexible proteins compared to the highly ordered globular proteins of SBF (Onimawo & Akubor, 2012). Good foamability is known to be associated with flexible protein molecules that could reduce surface tension while highly ordered globular protein which is relatively difficult to surface denaturation gives low foamability (Onimawo & Akubor, 2012). The low protein content and high content of insoluble components such as crude fiber of CPF probably discouraged the formation and stabilization of emulsion (Kinseda, 1987). This may affect the suitability of CPF for certain functions such as stabilizing colloidal food systems. However, these properties of CPF would be improved by blending it with SBF and WF as has been demonstrated for other composite flours (Akubor, 2003; 2004).

The least gelation concentration of CPF, WF and SBF were 8, 10 and 12 %), respectively. Least gelation concentration varies with different flours in which Sathe et al., (1982) associated the variation in the gelling properties to different ratios of protein, carbohydrate and lipid that make up the flour. Variation among these components play a significant role in functional properties as it affects galation. Flours with low value of least gelation concentration are reported to be good thickening agents. The CPF/SB/WF blend would be useful in snack foods where thickening and gelling is needed The structure of such gelled food systems provides matrix for retaining moisture, fat and other added ingredients.

3.3. Physical properties of cakes

The physical properties of cakes are shown in Table 3. All the cakes had the same diameter (6.1cm) and width (8.3cm). However, weight and height of the cakes decreased with level of CPF/SBF. The weight of the 100% WF cake was 127g and decreased to 105g for the cake containing 70% WF. Similarly, the height decreased from 5.7cm in the 100% WF cake to 3.4cm for the cake containing 70% WF .Gas retention is a property of wheat flour protein (gluten). During dough development, gluten becomes extensive and strong. This allows the dough to rise and also prevent easy escape of gas during baking. This property was reduced in cakes containing CPF/SBF, due to gluten dilution and appears to explain the lower height for CPF/SBF/WF cakes. Shittu et al., (2007) documented the basic determinant of loaf height to be the quantity of dough baked and the amount of moisture and carbon dioxide diffused out of the loaf during baking. Badifu et al., (2005) attributed increase in loaf weight to relative high moisture content, nature of carbohydrate and high bulk densely of flours. In this study, the decrease in weight of the cakes was probably due to inability of the dough to retain moisture during baking. The dilution of gluten proteins reduced gluten development which allowed escape of gas and moisture during baking.

3.4. Sensory properties of cakes

The sensory properties of the cakes are shown in Table 4. The 100% WF was rated higher than the other cakes in all the sensory attributes evaluated, probably because wheat is conventionally used to prepare cakes. Ratings for all attributes decreased steadily with the level of CPF/SBF in the blends. However, cakes containing up to 20% CPF/SBF were not significantly different ($P > 0.05$) from 100% WF cakes in all the sensory attributes. The colour and taste of the composite flour cakes may have been contributed by

phytochemicals in CPF (Ohler, 1979). A wheat flour substitution level increased, gluten proteins responsible for structure of baked goods were reduced and this probably interfered with development of gluten complex.

Table 5

Chemical composition of cakes prepared from cashew pomace flour (CPF), soybean flour (SBF) and flour (WF) blends

Parameter (%)	CPF/SBF: WF	WF
Ash	$2.0^a \pm 0.04$	$1.2^a \pm 0.05$
Moisture	$12.0^b \pm 0.05$	$14.0^a \pm 0.02$
Crude protein	$15.0^a \pm 0.005$	$11.5^b \pm 0.7$
Crude fat	$10.0^a \pm 0.01$	$8.0^b \pm 0.01$
Crude fiber	$2.5^a \pm 0.01$	$1.5^b \pm 0.024$
Carbohydrate	$58.5^b \pm 0.04$	$63.8^a \pm 0.01$

Values are means ± SD of 3 replications .Means within a row with the same superscript were significantly different (P>0.05)

3.5. Chemical composition of cakes

The chemical composition of cakes is presented in Table 5. The cakes containing 20% CPF/SBF had higher levels of ash, protein and crude fiber than the 100% wheat flour cakes. This was due to the high levels of these constituents in SBF and CPF. A high dietary fiber intake has been related to several physiological and metabolic effects. In the digestive tract, dietary fiber exerts a buffering effect that links excess of acid in the stomach, increases fecal bulk and stimulates the intestinal evacuation, Fiber also provides favourable environment for growth of beneficial intestinal flora (Lund,1984) and can also bind disease substances including cholesterol (Lund, 1984). These specific properties of dietary fiber play important role in prevention and treatment of obesity, atherosclerosis, coronary heart diseases, colorectal cancer and diabetes (Lund, 1984).

4. CONCLUSION

In the light of the results obtained from this study, it may be concluded that up to 20% cashew pomace flour/soybean flour bend could be incorporated into wheat flour to produce acceptable and nutritionally superior cakes than the traditional wheat flour cakes. Hence, development and utilization of the cakes would improve nutritional status and provide health benefits in developing countries. This is due to the presence of array of phytochemicals in CPF and SBF which may exert health promoting effects in addition to those of the dietary fiber. However, the storage stability of the cakes should be determined.

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